HOT Z-II

USER'S NOTES

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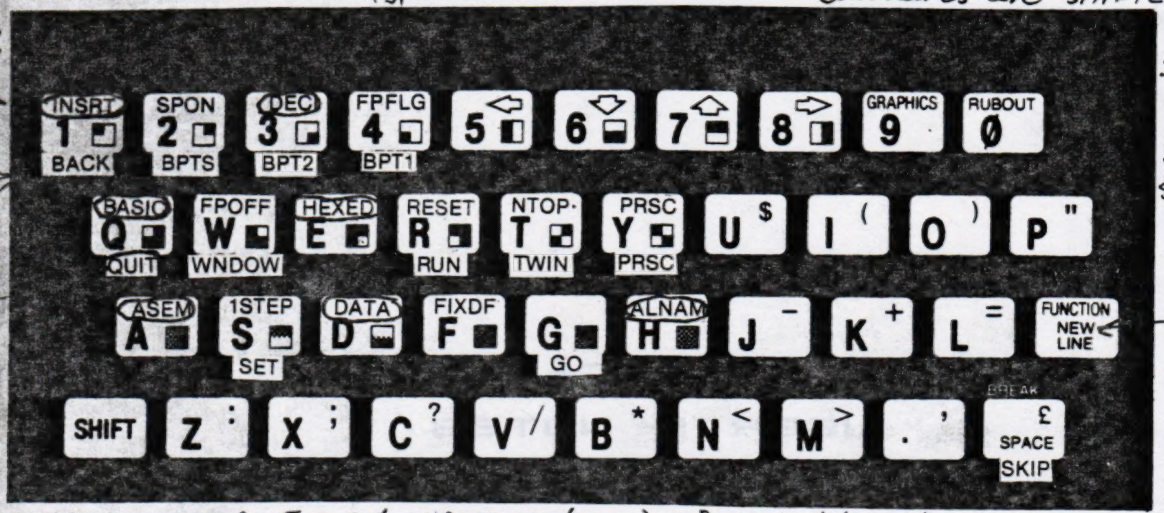
HOT Z-II COMMANDS

READ mode commands are listed at the top of the keys in the top of the two layouts below. Single-step commands are listed on the same layout below the corresponding keys.

WRITE mode commands are listed on the lower layout. FUNCTION key commands are not listed. Refer to your command list for those.

type address to set cursor. Commands are SHIFTED.

very useful in Edit or Assembly



Single-stepper

back to BASIC

3-enter decimal address to se

S-go to

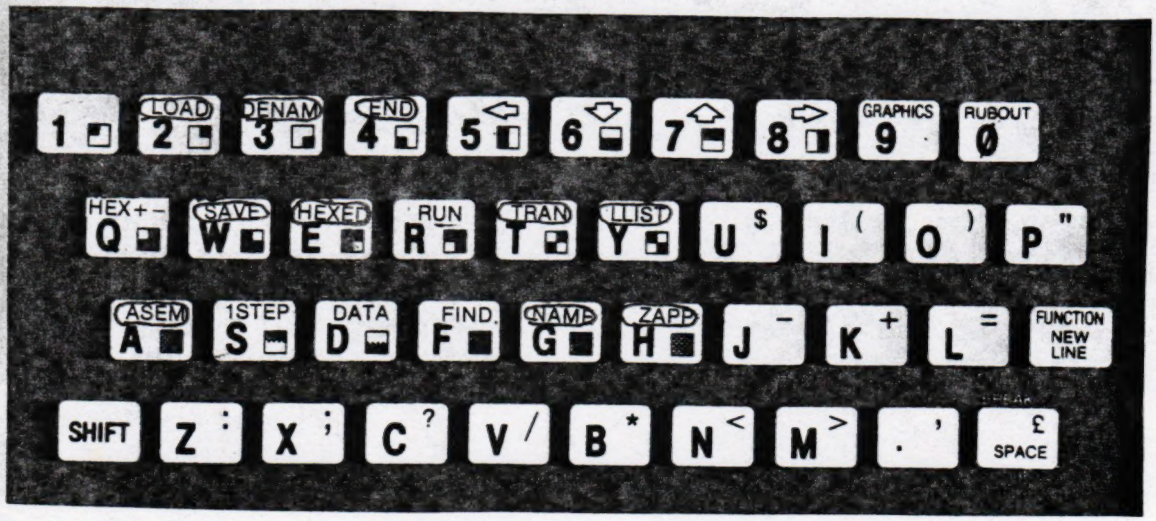
Set regs. in single-step mode

Enter: page through memory

H-swap name files

A,E : goto WRITE modes D - Back to data mode

Q-back to BASIC or exit single ste



A,E toggle between modes

T transfer cursor to END to DEST

Y Copy screen (dis-assem mode) or to END (write modes)

G Assign a name (must be in ASSEM mode!)

3 Zap a name " " " " "

4 Set END (very important command in Hot Z!)

The enclosed cassette contains the following:

16K HOT Z followed by Big REM followed by a NAME list. These are named HOT Z, BIGREM, and NAMES. The NAME list requires more than 16K. Load it from 2E82 to 4000 or from 8E82 to A000, for example. Then enter values at ALNA: 82-2E-82-2E-FE-3F; hit shift-H.

64K HOT Z followed by a NAME list for that version. These are named HOT Z and NAMES. A printed annotation for the NAME list will be available at nominal cost in the near future. LOAD the NAME list from E000 to F184 or any comparable memory space; values to set at FEE0 would then be 00-E0-00-E0-82-F1; then press shift H.

See the notes on loading for loading and backing up the tape.

in "Hi-Z", names table already included. You have room for a few additional names (temporary), but for more names you should set up alternate names file

THIS IS HOT Z-II

The enclosed tape holds versions of HOT Z-II for 16K and for 64K machines. However, HOT Z-II allows you to create your own customized version from the original. The only difference between the two copies on the tape is their memory occupation; the 16K user has all of the commands available to the 64K user, but of course much less workspace. If your projects with HOT Z are always cramped, then you should consider expanding your memory and installing one of the modifications that allows you to run code above the 32K boundary. (Use the 16K version as the simplest starting point for the relocations described in the later section on Relocating HOT Z.)

Those of you with 16K can only run the 16K version from the tape. However, you can test-load the 64K side to be sure that the cover comes up undistorted, which indicates a good load. (After you hit a key, the 64K version will crash in 16K.) With 64K you can use either version or create your own version to give you access to memory currently occupied by HOT Z.

We will assist those of you who have loading problems by exchanging your tape for an alternative dubbing. However, please do not make things difficult for all of us by using the oldest cassette machine in the house and sticking with it. They need constant cleaning and occasional adjustment of the head. Try borrowing another recorder before returning the tape. It is true that irregularities in tape and cassette cases do make some tapes unloadable, and we ask for no apologies when you return a tape. We have exchanged tapes widely and throughout the world, and about all we can say of the medium is that anything can happen.

HOT Z-II combines a line-by-line assembler, a labelling disassembler, a single-stepper and a simple editor. The purpose of HOT Z is to give you a reasonable degree of direct control of your computer, as well as to assist you in writing assembly-language programs to extend your control.

HOT Z will cohabit with a BASIC program, although BASIC is a foreign language to HOT Z and must be read as data when HOT Z is in command. Standard versions of HOT Z reside in high memory but below RAMTOP, so if you plan to work extensively with both HOT Z and BASIC you should use the command provided by HOT Z to move RAMTOP below HOT Z.

A minimum requirement for running HOT Z is some knowledge of the hexadecimal (hex) number system, which uses the characters 0-9 and A-F as its 16 digits. These instructions were written with the assumption that you know the fundamentals of Z80 machine code. If you do not, you should acquire a Z80 programming book. The one by Zaks (from Sybex) is useful, but those written specifically for the ZX are generally more simple. If you are learning, then use HOT Z as a blackboard to work out the exercises.

LOADING AND CASSETTE CARE

It is possible to ruin a data cassette in the same way as a floppy disk can be ruined. A low-quality or poorly maintained cassette player can impose glitches on a tape and make it unloadable. Dirty cassette players will eat tape. Don't take the chance. Make a back-up copy first and save this original for the day when the back-up fails.

LOAD your original tape with LOAD "". (LOAD "HOT Z" will work too.) With the 16K version, when the cover comes up and asks you to "PRESS ANY KEY TO BEGIN", you can make a copy by starting a fresh cassette on RECORD and pressing the S key. Your computer will output a backup copy to tape if you have it running. Any other key will start the program.

In more than 16K, you should be aware of the following method for duplicating any ZX tape that loads according to the ROM's BASIC protocol. That protocol requires that the data segment (as opposed to the name header) begin loading at address 4009 (VERS) and load as far as the address that comes up in 4014-5 (ELIN). With that knowledge, you can LOAD any tape as data, provided you LOAD to an offset from the intended area of the ROM's system variables (4009-407C).

For duplicating HOT Z or any long program, you need an extra 16K, that is at least 32K of RAM. Then get HOT Z running and learn how to use its commands. LOAD the original HOT Z tape via the HOT Z LOAD command with the cursor set at address 8009 and with END set to, say 8080H just for practice, then stop your recorder with the PAUSE key if you have one, but stop it, and rewind it immediatly so that you don't forget and start it in the middle, which is one way to ruin a tape.

Now your memory should read out an an offset *set* of system variables, the ones that will be coming in from the tape, and the address at 8014-5 (lo-hi) will give you one more than the last address to be loaded from the tape. Take that value, add the offset, and enter it as prescribed to set END (the TO key, as in TO the END), then start recording the tape from its beginning again. This time you will load a full copy, as data, of the tape's contents. If you just SAVE the same memory contents to another tape, then you have a backup tape that will LOAD in the normal manner from BASIC. You have also become a copier, and if you persist in that wantonly you will cause the extinction of programmers in your species of computer, which might foreshadow the ultimate disaster of model extinction.

The more important thing you can do with this technique is to change the program you have loaded and to save the new version. If you learn how to manipulate the system variables, you can create self-loading tapes of great variety. For example, you can direct where the ROM looks for its first BASIC line by setting the start address of that BASIC line into 4029-A (NXLN). If you are writing machine code for a USR call and if your routine sets NXLN before it does its RET to BASIC, then your reentry to BASIC will begin with the line whose address is in NXLN. Self-starting tapes also begin with the line that NXLN points to.

If NXLN points to VARS memory space, then the BASIC interpreter asks no questions but jumps up among the VARS and tries to read what is there as tokenized BASIC code. If you oblige it with a properly formatted BASIC line, then it does what you ask (e.g., RAND USR etc.) The important thing about introducing a machine routine from the variables block is that you can wipe away all your initialization code by a call to CLEAR, which is 149A in hex. HOT Z's initializer jumps into the memory space in the printer buffer (403C) to do that CLEAR, and then starts the program.

We are frequently asked how to get a copy of HOT Z onto a disk or a fast-load format. The ZXLR8 fast-load program has a data mode, which is ideal for saving HOT Z. You can even hook up the USR call that enters the ZXLR8 command mode as a HOT Z command, so that there is no need to go back to BASIC to use it. However, ZXLR8 returns in FAST and HOT Z requires SLOW, so what you need is an intermediate routine like CALL ZXLR, CALL SLOW, RET. (SLOW is 0F2B.) Then put the address of this routine into a dead key slot in the command file and use the corresponding key for the command.

With a data SAVE, you should save the entire HOT Z program, excluding the variables block, and then start HOT Z with its USR call after reloading. With the 64K version, you would have to save the HOT Z program and file blocks separately, so you would be better off loading the tape to B009H, as described above, and data saving that block, and then trick your system into reloading to 4009 when you want to use it. We regret that we have not had the opportunity to experiment with the variety of systems that are now available for the ZX/TS, but if your system lacks a data SAVE, then you should stamp your feet at the door of the producer of that system.

MEMORY MAPS

Brief memory maps of the versions on tape are as follows:

16K Version

4000	407D	4396	4400	4E00	5048	517B	5800	7F20	7FB0	8000
System Variables	Display File	Calculator Stack	Your Work Area	NAMEs Tables	HI Jump	HI Files	HI Program	Stack	HI Variables	

64K Version

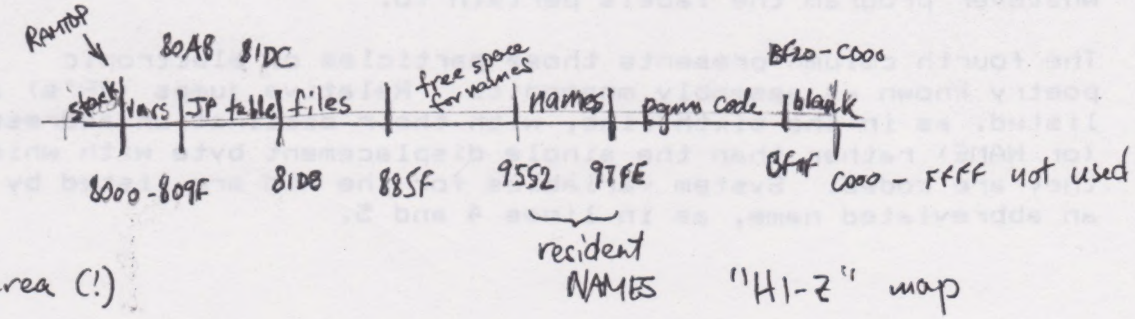
4000	407D	4396	4400	5B00	7F20	F3A0	F64B	F77B	FE00	FE60	FF00
System Variables	Display File	Calculator Stack	Your Work Area	HI Program	Work Area	NAMEs Tables	HI Jump	Files	Stack	HI Vars	

In 64K, the last 256 bytes above FF00 are unused.

RUNNING HOT Z-II

The following section provides an introductory tour of HOT Z. The experienced and the adventurous among you may want to plunge right in. If so, arm yourself with the short command lists and the keyboard map and try your luck. Details of the various commands are available in the later sections of these notes.

If you use HOT Z-II to best advantage, you will discover that it gives you a personal command of the machine (the Z80) itself, with a few exceptions that stem from your hardware. If those exceptions bother you then you might find it advantageous to improve your hardware. The most interesting hardware add-ons that we know of are currently coming from John Oliger, 10115 Nassau Lane, Indianapolis, IN 46229. These include a display board that turns your ZX/TS into a conventional Z80 computer with use of a full 64K memory.



AN INTRODUCTORY TOUR

The cover occupies the initial display file and evaporates when you press a key. Then you should see the first screen "page" of disassembled ROM. Down the left side of the screen, you will see the memory-address column, to which everything in HOT Z is keyed. These addresses are in hexadecimal and in the format accepted as input by the program. In other words, all addresses are four hex digits and include leading zeroes but no identifying symbols either before or after. The format is always there for you to consult as you make entries to HOT Z.

The address system runs from 0000 to FFFF, although the 16K memory goes only to 7FFF. In a standard 16K memory, you may find various parts of memory reflected into unused address areas, as for example a repeat of the ROM code at 2000, 8000, and/or at A000. This is hardware-caused, the result of incomplete address decoding. In 64K, you are liable to find that unused addresses above 8000 are cluttered with initial garbage, which HOT Z can clean up for you.

The second column of the disassembly display lists the contents of each memory byte, again in hexadecimal, two digits per byte, packed together with no spaces between. These numbers occur strictly in the order they occur in memory, which is not necessarily an easy order for reading. This column is raw data, as it were, against which any "interpretation" can be checked. Z80 instructions can be from one to four bytes in length. A HOT Z routine gets the length of any instruction and parses the bytes into instruction-length clusters, but it cannot decide whether those bytes hold true Z80 code, as here, or simply numbers used as data. That decision in the end is up to the reader. On this first page of ROM, the first instruction is two bytes long, the second three, etc.

The next column, the NAME column, will hold user-entered labels for the corresponding address, along with a few labels provided in a permanent file on your original tape. After you have annotated a program with these labels, you can SAVE a NAME file separately from HOT Z, to be loaded again with whatever program the labels pertain to.

The fourth column presents those particles of electronic poetry known as assembly mnemonics. Relative jumps (JR's) are listed, as in the sixth line, with their destination address (or NAME) rather than the single displacement byte with which they are coded. System variables for the ROM are listed by an abbreviated name, as in lines 4 and 5.

You are probably familiar with these first bytes of ROM through various PEEKs or publications. The first three instructions turn off the nonmaskable interrupt that makes SLOW mode work, load BC to count up to 16K of memory, and jump to the initialization routine at Ø3CB. The fact that only 16K is cleared by initialization is very useful if you have a larger memory and a reset button.

The rest of the screen is taken up by RST routines. RST 1Ø prints the character whose code is in A,RST Ø8 handles BASIC error reports, RST 18 and 2Ø help with interpreting BASIC, and RST 28 is the entry to floating-point operations, which are a separate sub-language in the ZX. RST Ø8 and 28 are always followed by one or more (for 28) bytes that serve as data rather than as machine code. The meaning of such bytes is listed in the mnemonics column.

The current HOT Z display is referred to in these notes as READ mode or disassembly. The commands in this mode are mainly for moving the display around to give access to different parts of memory. The page flip, for example, is the ENTER key; hit it to continue the disassembly with the instruction following the one at the bottom of the screen. For distant moves, you can enter a four-digit hex address to the ADDR cursor at the upper-left screen corner. For example, try Ø3CB to see the memory count and the initial loading of RAMTOP.

During address entry, you can backspace to correct an error by using the DELETE key, which works about the same way as it does in BASIC. The difference is that DELETE doesn't blank out the entry and that you can't back out of the whole entry routine that way. To back out, use the ENTER (NEWLINE) key, which works as an escape key in this situation. ENTER is not needed after the last hex address digit.

In READ mode, you can also get to a named routine by entering the four letters of an assigned NAME. Try KEYB. You will see that the NAMEs appear in both the NAME column (referring to the current address) and in the mnemonics column (referring to the target address of CALLs or jumps).

In general, you can use a NAME in the file as a proxy for its address in the READ, WRITE, or One-Step modes of operation.

Now try the shift-D command from READ mode. This is the display switch, and successive strokes of the the same key will take you back and forth between the data and the disassembly displays. The data display is for examining those parts of memory that are used as files of data rather than for Z8Ø code. The first and second columns contain the single address and its content in hex, values that are reflected in decimal in columns four and five. (Use it as a conversion

table.) The far-right column gives the CHR$ of the contents of the address and will turn up any BASIC programming or message files. Enter, for example, the address ØØ7E to see the keyboard file. Flip through using ENTER to see how the keywords are stored, with their final characters in inverse. Switch back to disassembly while you're still looking at the keyboard file for a taste of what disassembled data (sometimes called nonsense) looks like. It's up to you to distinguish sense from nonsense when reading a strange program; the display switch is there to help you do it.

The NAME column in the data display functions differently from the column with the same heading in the disassembly. The NAMEs in the data display are those that correspond to any two successive bytes, taken in lo-hi order, in the second column. (The disassembly displays NAMEs assigned to the addresses in the first column.) Some NAMEs in the data display can crop up by chance; for example, two NAMEs immediately together mean that at least one is spurious.

Use the T command in READ mode to go to the beginning of the NAME file. The NAME file grows downward like a stack, which it is not, as you add new NAMEs to memory addresses. Turn on the data display to see the structure of the NAME file. Each NAME takes six bytes; the first two hold the address to which the NAME is assigned, hence the listing in the NAME column, and the next four hold the NAME itself, which shows in the CHR$ column. Other odd CHR$ symbols will appear at random for some of the address bytes, signifying nothing.

The data display is also useful for looking at or creating display files.

You can enter decimal addresses to the ADDR cursor, but these must be prefixed by the shift-3 (THEN) command, which will put up a D after ADDR. Try it with 16384, which may be familiar. Check the conversion with the data display. If you enter a decimal address of less than five digits, then you have to press ENTER to tell HOT Z that you've finished. If you enter a decimal higher than 64K, the program will subtract 64K and give you what's left.

Now get into disassembly and go to 1CAA, which is where the ROM begins the BASIC function LN. Hit shift-W to turn on the floating-point interpreter. You will see here and on succeeding page flips some of the floating-point calculator language, which is described in another section of these notes. At 1CAF you will see a rendition of a BASIC error report after RST Ø8, in this case for a negative argument to the logarithm. You can switch off the f-p interpreter by hitting shift-W again, but you will have a more accurate rendition of the ROM if you leave it on.

The last display on the tour is the Z80 register display or Single-Stepper. It is one of the quirks of bilinguality that this display must be entered from an area where the floating-point interpreter is not switched on, so first enter an address above 4000, say. Then use the shift-S command from the disassembly.

The register display occupies the top three quarters of the screen. The left column lists the various Z80 registers; please refer to a good Z80 reference book if you need an explanation of the register names. The double prime, or quote sign, is the only symbol available in the ZX character set to denote the exchange registers. The exchange flags are listed as EXFLAGS.

The second column lists the hex values of the registers' contents. Values for the accumulator (A) are listed at the left of the column to remind you that A is the high half of the AF register pair, along with H, D and B. The third column either converts the second column value to signed-decimal according to the two's complement convention, or, if the second column holds an address that has been NAMEd, then that NAME is listed in the third column. The fourth column, headed by the open parentheses, gives the hex value of the byte contained in the address formed by the register-pair values. (E.g., across from HL you will find the byte (HL).) The right column gives the CHR$ of the byte in the fourth column (for the register pairs) or of the byte in A.

The box below the one containing the exchange registers holds details on the one-step user's stack and the state of the flags registers. The user's stack is separate from the main machine stack so that the system can absorb a few stack errors without crashing the program. The top four pairs of bytes on the user's stack are shown at the right, along with the NAMEs for any addresses they might hold, so that you can check to see whether your test routines leave anything behind. The main flags are listed below the exchange flags for easier visual association with the conditionals in the program steps below. Standard conditional mnemonics are given for the four programmers' bits.

The inverse-printed address at the left in line 18 serves both as a cursor and to mark the address of the next step set up to be executed by the single-stepper. You can enter any address into that cursor just as you would in READ mode, or you may also use a NAME. The ENTER key still serves as an escape during address or NAME entry, but it has another more important function as well, which is to run the next single step.

If it's not already there, enter 0808 to the NEXT slot, and then notice the contents of the A and D registers just before and after you press the ENTER. This is a fairly safe area and you can experiment with a few more steps. (The things you must be careful about are loading into some system variables, either ROM's or HOT Z's, and some flag sets. LD (DF_CC),HL is usually program hari-kari, for example. The SPACE key allows you to skip the step at NEXT. The top line of Z80 instructions represents the previous step executed, and the three steps following the one in NEXT are those that will be reached if there is no branching. A branched-to step appears directly in the NEXT slot; a skipped step disappears from the display.

For faster debugging, you can set breakpoints (shift-4 and shift-3 commands) and use the shift-G command to step through the code as far as the first breakpoint encountered. Two breakpoints are provided so that your can cover both sides of a conditional branch. You must take care to set breakpoint addresses that the code will actually encounter, since stopping depends on finding a breakpoint exactly. The BREAK key will stop the shift-G command if used quickly enough. You can display the current breakpoints with the shift-2 command.

Learners might consider mastering the use of the Single-Step first and then using it to see how the various instructions and a few resident routines work. A lot of bugs can be avoided by testing every routine you write with this device.

Hit shift-0 (Quit) to get back to the main READ display. You will arrive at a screen page that starts with the address that was in the NEXT slot of the Single-Stepper. If you spot an error coming up at the bottom of the Single-Step display, you can quit the display, EDIT the error on the disassembly display, and get back to where you were in the Single-Step by using the shift-S command from READ mode.

Writing and Editing Z80 Code

The READ mode is a essentially passive, allowing you to page through the memory and examine its contents. The WRITE or EDIT modes are there to let you make changes in the memory content, provided that memory is RAM.

There are essentially three WRITE/EDIT modes. With the disassembly display, you can press shift-A and a cursor will appear at the top line of the edge of the right column. This is the assembly mode. Once you turn on the cursor, you change the entire command system of HOT Z. The commands available to you with the cursor on are listed as the WRITE-mode commands on the command lists. Hitting ENTER with the cursor in its "home" column will quit the WRITE mode and return you to READ, where you can readjust the screen to another part of memory.

In addition to the command set, the up and down cursor controls allow you to move the cursor to a given line or to scroll the display page one line up or down by moving the cursor up from its top position or down from its lowest position. Up scrolling is automatic when you ENTER a line that is third from the screen bottom.

You may also enter a new Z80 instruction to replace the one listed on the cursor line. Just start typing and the existing line will disappear. As you type, the delete key and the left and right cursor controls will function as you expect them to. If the cursor is over the top of a character, your next keystroke will replace that character. If you want to insert a character, press the EDIT key (shift-1) and a space will be created at the cursor position, with all characters to the right of the cursor being shifted one space right. The rightmost character in the line (usually a blank) is destroyed by this insert command. You cannot jump to another line with the up or down cursor command while you are in the middle of editing a given line.

When you have entered the intended Z80 instruction, hit the ENTER key to put the proper code into memory. If your entry is in the proper format, the cursor will return to the left edge of the column and move one line down, ready to edit the next line. If the cursor stays put in the line you are working on, then it indicates a format error in the mnemonic entry.

HOT Z-II follows the format of the mnemonics listed in the Zilog Z80 technical manual. This format is essentially the same as that listed with the character set in your computer's instruction manual, with the following exceptions: the RST's are followed by a hex byte (08,10,18,20,28,30,38) rather than decimal and the OUT (N),A and IN A,(N) use the parentheses shown here. (N is always a two-digit hex byte.) As a general rule, the open parenthesis is always preceded by either a space or a comma, and spaces are always important.

When HOT Z fails to accepts your entry, it locates the line cursor at the first position that does not match its template for a proper instruction. Sometimes, however, as with an omitted space or an unassigned label, the cursor may appear earlier than your particular format error. (For example, it will flag the first letter of a label even if only the fourth letter is "wrong".)

If you get stuck and can't get HOT Z to accept what you've entered, you can abandon ship and restore the original mnemonic by hitting the FUNCTION key. Your recourse then is to look elsewhere in the disassembly for the format of the instruction you have been trying to enter, or to look up the hex code for that instruction and to enter that in the hex column (See below.) to discover how HOT Z lists the mnemonic.

If you try to back out of a line with the cursor-left key, HOT Z will act as if you have tried to ENTER the line. If you write all the way to the end of the line an ENTER will also be automatically appended. This occurs with some of the IY+N instructions, which just fit in the alloted space.

You can use a preassigned NAME in an instruction anywhere that a 16-bit (four hex digits) number occurs. For example, LD HL,(RMTP) is equivalent to LD HL,(4ØØ4). You must give a NAME to a particular address (shift-G command in WRITE) before you attempt to use it in an instruction.

Relative jumps (JRs and DJNZ) are normally entered with the destination address or NAME. However, for the JRs only (not DJNZ) a second form is available for short forward jumps where you haven't yet assigned a NAME but know how far forward you want to jump. JR +5 will jump ahead over five bytes. The plus sign is required and the displacement is in *decimal* with a range from Ø to 127. Backward jumps are not catered for in this way; it is easier to look back for the address you want to get to.

Provided you do not want one of the last four conditional expressions (M, P, PO, or PE), you can use relative jumps all the time, and if the destination address is too far away HOT Z will convert your JRs to JPs (absolute jumps) rather than report an error. The reverse is not true: if you enter a very short absolute jump, HOT Z will take your word for it. This conversion works well for entry of new code, but you must beware when editing in the middle of an existing routine, because if a two-byte JR is edited and becomes a three-byte JP, then the first byte of the following instruction will be overwritten.

There is no ORG command because you are doing the ORG yourself with HOT Z. However, direct data entry is possible in the assembly-edit mode through use of the DB pseudo-op. DB may be followed by a quoted string (DB "ABCDE") or by an even number of hex digits (DB Ø9ØF ØD3A). Spaces are ignored in reading the hex digits, except for the required space after the DB. Each pair of hex digits is read as one byte, and a single digit left over will be ignored. You can write a string or series of digits all the way to the end of the line.

When you hit the end, HOT Z will add the quote if necessary and enter the line. Upon entry, the editor enters one character (for a string in quotes) or two hex digits per byte starting with the cursor address for as many bytes as it takes, then resets the screen layout so the next cursor address is at the top of the screen. The reason for this is that the data you have entered would be disassembled by HOT Z, producing a nonsensical listing. You can look back with the data display to assure yourself that what you have entered is indeed there.

The DB is simply a means of entering data without leaving the assembly-edit mode. You should still assign NAMEs to your strings or variables and use them in referencing the data. The insert command is recommended when you enter data into an existing code block.

If you want to use the RELOCATE command (described below), then you should not mingle small blocks of code and data. Keep them in large blocks and keep track of what is where.

In addition to string entry with DB, you may also enter quoted non-inverse characters for direct eight-bit register loads or for direct arithmetic/logic operations. LD A,"A" will assemble as LD A,26 and CP "Z" as CP 3F. Sixteen-bit (double) register loads are not treated in this way.

Hex Edit Modes

Hit the shift-E key with the disassembly display to get into the main hex edit mode. The "home" column for the cursor in this case is between the address and hexcode columns at the left of your screen. Cursor controls work as with the assembly-language editor.

To change the hex content of memory, you may either move the cursor over with the cursor-right key or retype the line, using the keys from Ø to F. With the disassembly display, each line holds the correct number of bytes for a single Z8Ø instruction. If you write a one-byte instruction, the cursor will jump to the next line immediately; for multi-byte instructions, the cursor waits on the line until the required number of bytes have been entered, then jumps automatically. The purpose of this feature is to allow you to copy hex listings from printouts or magazines. You can just type away without worrying about hitting ENTER at every line, and the screen will scroll along with your entries.

With the edit mode, what you see in the hex column is what you get when you make an entry, byte for byte. Edit does not use NAMEs and you have to calculate the displacements for any relative jumps you enter.

All of the WRITE-mode commands are available with the hex-edit cursor on screen. There is, however, no character insert while you are editing a line, and the escape key in the middle of a line is ENTER rather than FUNCTION. If you need to change the first byte of a line after you have started editing it, you should escape by hitting ENTER and start over.

You can hit the shift-D (display switch) key either before or after you have gone to the hex-edit mode in order to obtain the data-edit mode. This mode lets you change one byte at a time by writing a new value over the top. This is the mode that you would use for entering hex data files, addresses and the like. (Use the DB command from the assembly mode for entering text files.) All write commands are available from this mode as well, except the NAME (shift-G) command functions differently than it does with the disassembly display. Shift-G will no longer assign a new NAME, but can be used to write a preassigned NAME to the NAME column, and the address to which that NAME belongs will then appear at the cursor address and the byte following. The intended use is for creating address files (jump tables).

Inserting and Deleting Lines (All WRITE/Edit Modes)

What happens when you press ENTER after writing an instruction is that HOT Z reads the address of the line you are working on, looks up the the numeric code of the instruction, and enters that code into as many bytes as it takes. Then control goes back to the disassembler, which reads back your code into Z80 mnemonics and revises the screen page accordingly. An important consequence of this is that when you are editing an existing block of code you must be careful not to overwrite more lines than you intend to (by entering a four-byte instruction over a two-byte instruction, say) and to watch out for new instructions that crop up when you overwrite a long instruction with a short one (one-byte over a three-byte instruction, for example).

If you don't know the byte length of Z80 instructions, the way around the above problem is to use the line-insert (shift-1 or EDIT) and line-delete (shift-H) commands whenever you are editing an existing block of code.

When you insert or delete a line, a block of code is moved either to make room or to close up the empty space. One end of that block of code is determined by the cursor; the other end must be determined by you before you start your editing session. Whenever the WRITE cursor is on, a variable called END is displayed in the upper right corner of your screen. END marks the other end of the active memory block for an insertion or a deletion or indeed for any block operation, such as a clear, a fill, a SAVE, or a transfer. END is set with the TO key (as in TO the END) followed by four hex digits or a NAME. On some types of entry errors, you may be asked twice for the proper value.

You should set END whenever you begin an editing session. END should be within your workspace and not overlap with the HOT Z program, lest you move sections of HOT Z around and lose control of your computer. For the insert-line and delete-line commands, a special restriction has been added to the value of END. For those operations, END must be within 256 bytes of the cursor address, or else you will be asked (automatically) to enter a new value of END when you give the insert or delete command. At that point, HOT Z will accept any value you enter for END and perform the operation. The purpose of this behavior is to catch those times when you have forgotten to set END, and to save you from a possible crash.

For insertions and deletions, END can be either above or below the cursor address. The "usual" value would be for END to point to an address higher than the cursor address, in which case an insertion would push all values to higher addresses to make room for the new instruction. For example, if you insert a two-byte instruction at 4C1Ø with END set to 4C8Ø, then all instructions from 4C1Ø will be moved two bytes higher until 4C7E, which will go into 4C8Ø, and the original contents of 4C7F and 4C8Ø will be destroyed. A deletion of a two-byte instruction would move all instructions to lower addresses, and the contents of 4C7F and 4C8Ø would be duplicated in 4C7D and 4C7E.

On the other hand, if the address in END is lower than the cursor address, then an insertion will leave the following addresses undisturbed but will push the contents of preceding addresses to lower addresses as far as END. For example, with END set to 4CØØ and the cursor at 4C1Ø, insertion of a three-byte instruction would destroy the contents of 4CØØ, 4CØ1 and 4CØ2 by overwriting them with the contents of 4CØ3, 4CØ4 and 4CØ5, respectively. Analogously, a deletion would duplicate the first three (or N) bytes in the next three. The insertion itself will in this case go into the address *preceding* the cursor address. This feature is useful when you are editing in a constricted memory block with blanks that may be either above or below.

After insertions or deletions, the cursor position may have to be adjusted for your next entry. (The preceding discussion uses "above" and "below" to refer to numerical values of addresses, not to screen position, where addresses get higher as you go down the screen.)

When a NAME is assigned within a block where you are inserting or deleting lines, the NAME will move with the instruction to which it is assigned. The displacement assigned to relative jumps is not adjusted, so JR TARG may read JR 4C22 after an insertion that pushes TARG from 4C22 to 4C23. Be sure and label all JR destinations and then check that the labels are still correct after an editing session. If you use labels all the time, then an error will stand out clearly.

When you are editing the data display, all insertions and deletions affect one byte at a time.

Using WRITE Commands

Many of the WRITE commands affect a block of memory and require that the END variable be set first to a proper value. Use the TO key to set it. Aside from its use for insertions and deletions of lines, END is generally set to denote the end of a block of code, whereas the cursor marks the beginning. If END is less than the cursor address, the block is generally taken to be null, though sometimes the operation will still affect the very first byte. Most operations include the END address; the exceptions are SAVE and LOAD, which finish one byte before. (This makes it effectively impossible to LOAD or SAVE address FFFFH, since the next address is ØØØØ, which is less than any cursor address.)

The block commands are LOAD, SAVE, FIND, transfer, clear, fill, print, readdress and relocate, in addition to the line insert and delete described above. The simpler commands are shift-A and shift-E, which toggle the cursor across the screen between assembly-edit and hex-edit; shift-D, which toggles the display between disassembly and data and works only in hex-edit because you can't assemble data; shift-G and THEN, which allow you to assign or delete a NAME at the cursor address; shift-S, which takes you to the single stepper; shift-R, which transfers control to the program beginning at the cursor (Novices beware!); and FUNCTION followed by the 2-key, which moves RAMTOP and the stack to the cursor address and those *below*.

The two cassette commands (LOAD and SAVE) allow you to move the contents of individual blocks of memory back and forth to and from tape. Such tapes will only be loadable by the corresponding BASIC command if the bytes of memory are in the format of a BASIC program, as explained in the earlier section on copying tapes. However, you can save your machine-code program drafts and your NAME files with HOT Z, and then load them again to continue working on or testing them. The LOAD and SAVE addresses do not have to correspond, but you must have the same block length from cursor to END if you want to preserve the whole tape. (This is why you can load BASIC tapes at an offset.) If you LOAD a tape that is too long for the assigned block, the extra part is cut off; if you attempt to LOAD a tape that is too short for the assigned block, you will get the familiar "searching" pattern on screen when the live part of the tape ends; hit BREAK to restore HOT Z and the portion of memory loaded. If you BREAK during the active portion of a SAVE, HOT Z will restart itself, losing the value assigned to END and initializing the stack, the NAME file, and any values held in the register display. (Your NAME file can be recovered. See the section on NAMing.)

LOAD and SAVE both take tape names, which are entered without quotes after you give the command and before you press ENTER. Maximum length for such tape names is the length of the command line (top) on which they appear. If you exceed that length, HOT Z reads an ENTER and begins to execute the command.

The TRANSFER command allows you to move the contents of one block of memory to another block. The first thing to do is to make sure that your destination block will hold the source block without overwriting something you want to keep (or HOT Z). You have the option of copying just the code (shift-T) or of copying the code and moving the NAMEs assigned to it as well (FUNCTION-6). The original of the code will not be erased by this command. You can copy from ROM but of course not into it.

To use the transfer command, set END and hit the appropriate command keys. This will bring up a DEST cursor at the upper left, which asks you for the destination address of the block. HOT Z will wait for you to hit ENTER after that address, and if you change your mind or find you've entered it incorrectly you can bail out by hitting the SPACE key instead of ENTER. After the command has executed, the display will move to the address you gave to DEST.

The FIND command has a similar protocol to that of transfer. In this case, set the cursor to the beginning of a block of memory for which you want to find a match. Set END to the last byte of your template. Hit shift-F. An address cursor labelled LOOK will come up at the upper left. Enter the address at which the search should begin; hit ENTER to proceed or SPACE to back out. HOT Z will search 16K (4000H) bytes for a match to the memory from cursor to END; if a match is found, the display moves to it; if there is no match, the display remains at your template in READ mode. If you find one match and want to search for another, set the cursor again (shift-A or shift-E), move the cursor down a line or two so it doesn't point to the beginning of the found match, and use the FUNCTION-F command. If a second match is found, the display will move to it; if not, the display stays put. (NOTE: If you are searching for a block of 8 zeroes, say, and you find a block of 12, then to continue the search you should move the cursor down so that there are 7 zeroes or less below it, or else you will find the same string all over again.

The CLEAR command (FUNCTION-Ø) will put zeroes in all bytes from cursor to END. The FILL command will first ask you for a keystroke and then fill the block with the code for the character assigned to that key. If you clear or fill a block of HOT Z or the stack, you are likely to crash.

The PRINT-SCREEN command in WRITE will send the contents of the screen, starting with the cursor line, to your 2Ø4Ø printer or to the Memotech parallel interface. Printing will continue, interrupted by page flips of the display, until the bottom of the screen that contains the END address. If you forget to set END, you can BREAK to save paper.

There is also a hex-arithmetic command, which, though not a block command, uses both the cursor address and END. The command is shift-Q, and the result is the hex sum and difference (END minus cursor address) of the two values, which are displayed in the command (top) line.

The Readdress (for jump tables) and Relocate (for programs) commands are described in a later section of these notes, due to their complexity.

A detailed description of all the HOT Z commands is also included as a later section intended for occasional reference. For normal use, you may want to detach the brief command lists and the keyboard map included at the beginning of these notes. Other sections will give you details on naming and NAME files, the floating-point language interpreter, and the program relocator. If there are specific commands which you find absolutely opaque or unusable, please write to us for details.

HOT Z's Flags

HOT Z uses the byte at 4Ø21 in the ROM's system variable space as 8 bit-flags, so you could crash the system if you try to load that byte. The significance of the bits is as follows:

Ø	Set for disassembly of RST Ø8h
1	Set for disassembly of RST 28h
2	Set for an INSERT in progress
3	Set by an input NAME, reset by an ADDR
4	Set for data display
5	Set for EDIT, reset for WRITE
6	Set for a scroll
7	Set for window in register display

HOT Z also uses 4Ø7B and 4Ø7C to hold a restart address in case you fall into a BASIC error trap (RST Ø8). Occasional use is made of the system variables PPC, OLDPPC and STRLEN, but this use does not, to our knowledge, affect the operation of a co-resident BASIC program.

DISASSEMBLER FEATURES

The HOT Z disassembler has been specially programmed for the ZX 8K ROM. The special features that are catered for are the system variables, the BASIC error reports, and the floating-point operations, which make up the 'calculator language' of the ZX.

Abbreviations of system variable names are included in the permanent NAME file that loads with the program. The HOT Z disassembler always uses the name for a system variable whether it is referred to by absolute address (e.g. 400C) or by a displacement from IY (IY+0C). However, if you want the IY form from the assembler, you must write it out, since the assembler will always substitute an address (two bytes) for an entered NAME. We have added DBNC (debounce) for 4027 (decimal 16423) and HZFG for 4021 (16417), which is used as a flag byte by HOT Z. Since these system variable names are part of a NAME file, you can change the abbreviations to suit your own taste by entering a new NAME over the top of the old one (shift-G command in WRITE).

HOT Z-II also uses the system variables PPC, OLDPPC and STRLEN, but this should have no serious on a BASIC program in memory with HOT Z. CALLs you make to ROM routines should not fail for incorrect system pointers. If you use the floating-point routines, you should load HL' with 10D2 before making the CALL.

When an RST 08H is executed, the byte following the RST is not code but is used as data to generate the BASIC error report. HOT Z reads these bytes as ERROR 9, etc., rather than generating Z80 mnemonics for them. If you are running the disassembler over a block of data, you may see some queer results, like ERROR Z.

An RST 28 is the ZX ROM's entry into the floating-point language, which is normally disassembled by HOT Z. If you find this second language distracting, you can switch off the f-p language interpreter with the shift-W command (READ). If you want to know what is really going on in the floating-point routines, then consult appendix A of these notes.

THE COMMAND SET

All commands are on shifted keys in order to allow all of the alphabet for assembly editing. Following is a description of each command. Remember to use the shift key with all commands except ENTER and SPACE.

READ Mode

Key	Description
A	Sets the cursor to the top line and switches to the assembly-edit mode. The same keystrokes will get you from hex-edit to assembly edit. This command works only when the disassembly display is on.
AND	(Shift 2) Switches on or off a display of the stack-pointer address in the upper right screen corner. The default is Off, because it isn't pretty, but you should turn it on when you are test running your own routines. There is a small amount of shock absorption in the HOT Z stack, but if you should see it changing, you should reset it with the R command (Read) and then look very carefully at what you are doing to the stack with the routine you are testing.
D	The display switch from disassembly to data display or back again. The same command works with the hex-edit cursor on but not from assembly-edit.
E	Sets the cursor to the top line and switches to the hex-edit mode. This command also works from assembly-edit mode without resetting the cursor line.
F	Fix display file. Combs the display file and sets all the line endings. Use it when one of your experiments messes up the display. If you are in READ mode, this command should work even without an ADDR cursor.
H	NAME file switch. If you are using only one file, the NAMEs are switched off or on. If you have two files in memory, the command will switch from one file to the other. The point of the double NAME file is for revising a program under development, so that you can use the same NAMEs at two different addresses.
Q	Quit HOT Z for BASIC. HOT Z remains resident and can be recalled with RAND USR 22528. If you want to protect HOT Z, move RAMTOP first with FUNCTION-2 (Write).

R — Restarts HOT Z. Reinitializes variables and resets the stack. Purpose is to clear clutter from the stack.

S — Switch to single-stepper. The address in the NEXT and LAST slots will be last ones used there. Use this command to get back after you have spotted and repaired an error in the upcoming code. All old single-step register values are preserved.

T — Move the display to the start of the NAME file and switch to the data display. Use this command as preparation for SAVing a NAME file. (Turn on the cursor, set END, and SAVE.)

THEN — (Shift-3) Indicates decimal address to follow. The command will add another inverse block to the ADDR cursor. If the decimal address is less than five digits long, hit ENTER after the last.

TO — (Shift-4) Floating-point disassembler switch. This is a flag switch (NOT an on-off switch) which switches interpretation of a byte from Z80 language to floating-point language. This command is necessary for certain embedded sections of floating-point code that are not preceded by an RST 28 but are jumped to from some other portion of floating-point code. This command will not function if the W switch has been set to off. If it doesn't work, hit shift-W and try again.

W — Switch the on-off state of the floating-point disassembler. If turned off, then the TO (Shift-4) command will have no effect. If on, then every EF (RST 28) will switch to the floating-point disassembly and every 34H will switch off the floating-point disassembly. If you have a stray EF on screen while you are in an edit mode, you may get a messed up display when you enter code. If so, exit (ENTER) from edit mode, use this shift-W command, and go back into the active mode without fear. Default state is ON.

Y — Prints the screen. Useful for small routines. Gives you headings and all. Consider using the same command from an edit mode for no headings and variable length.

WRITE Mode Commands

A — Switch to assembly-edit mode. Works only when disassembly display and edit mode are on. Moves the cursor horizontally.

AND — LOAD from cursor to END. Works exactly like the HOT Z-1 command. If you enter a tape name (no quotes), then the tape is searched for a header with that name. If no name is entered, then the first band on the tape is loaded. The first byte after the tape name is loaded to the cursor address and the rest follows. Loading stops at the byte before END. if the tape does not contain sufficient data to fill memory to END, then the familiar "waiting" pattern comes up on screen. You may BREAK from this command. BASIC tapes begin at 4009H and will load from HOT Z if there is space in memory.

D — Display switch, data/disassembly. Works only from hex-edit mode.

E — Switch to hex-edit mode from assembly edit. Moves the cursor horizontally.

EDIT — Sets the Insert mode for the next instruction (only) to be entered. If END is less than the cursor address, then instructions are pushed to lower addresses (up the screen) as far as END; if END is greater than the cursor address, then instructions are moved to higher addresses (down the screen) as far as END. Any NAMEs assigned to shifted memory area will also be shifted so that they stay with the instruction to which they were assigned. Relative jumps to or from the shifted area are not corrected and may require a fix-up. If END is 256 bytes or more from the cursor address, you will be required to confirm the END value before the operation proceeds.

ENTER — Quit to READ mode when cursor is in "home" column. During hex entry, ENTER escapes and leaves the original memory contents intact. During mnemonics entry, ENTER sends the line contents to the assembler for entry into memory.

F — Find the string marked by the cursor (first byte) and END (last byte). Sets the display to start with the found string. If no match is found, then the display remains at the template string. To find the next match without going back to the template, use FUNCTION-F. Do not use other commands between the F command and FUNCTION-F.

FUNCTION During mnemonics entry, escapes and leaves the original memory contents intact. When cursor is in the "home" column, FUNCTION changes the cursor to inverse F and acts as a prefix to the FUNCTION commands listed below.

G NAME command. This command has two separate effects, depending upon whether it is used with the disassembly display or the data display. With the disassembly display, the effect is to christen that instruction with the NAME that you enter to the screen following the command. As with HOT Z-1, a NAME is four letters with at least one beyond F in the alphabet.
With the data display, the NAME you enter following the command must already be assigned to some address. HOT Z then looks up the address for that NAME and pokes that address to the byte at the cursor address and the byte following, then moves the cursor down two bytes. Use this form for entering tables of addresses.

H Deletes the instruction at the cursor and closes up the code between the cursor and END. END may be either lower or higher than the cursor address. If END is less than the cursor address, then code is moved from lower addresses to close the space; if END is greater than the cursor address, then code is move from higher addresses to close the space. Code at the END address and beyond (moving away from the cursor) is preserved. If END is 256 or more bytes away from the cursor, then you will be asked each time to verify the END value before the command is executed. The purpose of this is to prevent your messing up the entire memory by forgetting to set END properly.

Q Does hex arithmetic. Takes the cursor address (K) and END (E) and displays on the top line the sum (E+K) and difference (E-K) in hexadecimal.

R Runs code beginning at the cursor address. Returns to HOT Z with the first RET. If you do an extra POP and destroy the return address, then you are on your own. (This command differs from the similar one in HOT Z-1, which requires a JP back to HOT Z.) Recommended procedure is to test your routines first with the single-stepper before attempting the R command.

S Single-steps the instruction at the cursor address and switches to the single-step display with the result of of that instruction in the register values and the following instruction in the NEXT slot.

T — Transfers code between the cursor address and END (inclusive) to a destination (DEST) that you enter following the command. ENTER after DEST executes the command; SPACE after DEST cancels the command; TO (shift 4) after DEST lets you reset END before the command is executed. Does not transfer NAMEs. To do that, use the FUNCTION-6 command, which is otherwise identical to this one.

THEN — (Shift 3) Deletes the NAME at the cursor address from the current NAME file. This command will only affect the NAME that you see on screen with the disassembly display, so it is best not to use it with the data display.

TO — Brings up the END? cursor that allows you to reset the END variable. Whenever a block of code needs to be marked, it is generally delineated by the cursor address and the address assigned to END. Always use it to block out a segment of memory for Insert and Delete commands before beginning to edit. END should be set within 256 bytes of the cursor for editing, but that restriction can be overridden in any particular case. (See Insert and Delete instructions.)

W — SAVEs code from cursor to END-1. Enter a tape name without quotes. This is a data SAVE. If you want to reload such tapes from BASIC, they must begin with a proper set of system variables. (First byte loads to 4ØØ9H in BASIC.) If you load in a BASIC tape anywhere in memory and change it judiciously, then SAVE the same block with this command, you should be able to reload the result from BASIC.

Y — Outputs the screen without headings from the cursor address to END to your ZX printer or Memotech I/F. Will print slightly beyond END to fill out the screen on which END occurs. A variant of the COPY command.

FUNCTION Commands: Hit FUNCTION first, then the second character listed below. (F stands for FUNCTION.)

F-1 — Clears memory from cursor address to END. Take care not to erase HOT Z or your own programs.

F-2 — Fills memory from cursor address to END with the code for a key that you specify in response to the KEY? prompt.

F-3 Moves RAMTOP to the cursor address and moves the machine stack to the addresses just below. Be sure there is enough clear memory in the new location before moving the stack. (Turn on the SP display from READ (AND key) and look at RAMTOP (4ØØ4-5); subtract for the stack size and allow an extra 4Ø bytes for stack excursions.)

F-4 Dead key.

F-6 Transfer memory contents and assigned NAMEs from a memory block (cursor address to END, inclusive) to an area beginning with an address entered in response to the DEST prompt. (See shift T command.)

F-7 Readdress a jump table (address file) between the cursor address and END by a 16-bit displacement value entered in response to the DISP prompt. Takes the address (lo-hi order) at each pair of memory locations, adds the displacement, and re-enters the sum to the same locations.

F-8 Relocates Z8Ø code between the cursor address and END. Readdresses all CALLs or JPs. Allows a three-way partition of code, variables and (constant) files. Requires nine addresses to be first entered at TEM1 through TEM9. See the special instruction sheet on this command.

F-9 Initializes display window for single stepper. Set the cursor to a block of 768 bytes of clear memory and give this command. Then go to Single-Step mode and use the shift-W switch to see the result of those steps that put a character on the screen.

F-F Continues the search for the string specified in the F command. Starts searching from the current cursor position. (If, for example, you are searching for a block of six empty spaces and you find a block of nine, then you should move the cursor down four spaces or more, so you don't refind the last eight spaces, then the last seven, etc., of the same block.) Uses temporary variables that could be overwritten if you stop in between for other operations.

SINGLE-STEP MODE

Key	Function
AND	Display breakpoints. Lists the current setting of the two breakpoints on the line below the flags display.
EDIT	Backs up. On its first use, this command takes the instruction from the LAST slot at the top of the disassembly listing and puts it in the NEXT slot (second line). Repeated use with no intervening commands will back up one more byte for each keypress. Intended use is just to get the last step back.
ENTER	Runs the instruction in the NEXT slot and reports the resulting register values.
G	Go (run) to breakpoint. Causes the test routine to run from the address in the NEXT slot to either of the two breakpoints, which must be set in advance of this command. Breakpoints must be set to an address that starts a command and not to a byte embedded in a command. The GO routine checks the BREAK key after executing each line of code, so you can recover from endless loops and sometimes from runaway routines (if you're quick) by hitting BREAK. If you are using the window, it should be switched off for this command.
Q	Quit single-step and return to READ. Return address is the address in the NEXT slot of the single stepper. Register values will be preserved if you reenter from READ mode.
R	Run a CALL or RST 10. It is your responsibility to know that the called routine will not crash and not to send RST 10 any unprintable characters. The purpose of this command is to shorten the time needed to step through complex routines.
S	Set register value. The response to this command will be REG? in the NEXT cursor. You should respond as follows for the various registers:

A for the A register
B for the BC pair
D for the DE pair
F for the Flags register
H for the HL pair
S for the user's Stack Pointer
X for the IX pointer
Y for the IY pointer

(S) Note that all settings are 16 bits (two bytes) except for the one hex byte for A and the mnemonic setting for F. The specific flag bits are set or reset with the same mnemonics as are reported (M, P, Z, NZ, PO, PE, C, NC). Use this command to set up initial conditions for testing your routines.

SPACE Skip the step in the NEXT slot and advance to the next instruction. Skipped instructions are not listed in the LAST slot at the top of the disassembly segment.

T Twin the breakpoints. Sets Breakpoint2 = Breakpoint1.

THEN Set Breakpoint2. Breakpoints are set just as register pairs are, with a NAME or address entry into the NEXT cursor. You must set the breakpoints precisely to the beginning of the instruction at which you want the single-step to stop, because the stop depends on the address of the next step being exactly equal to the breakpoint. If the breakpoint points to the second byte of a two-or-three-byte instruction, you routine will never stop until you crash or hit BREAK.

TO Set Breakpoint1. Breakpoints are set just as register pairs are, with a NAME or address entry into the NEXT cursor. You must set the breakpoints precisely to the beginning of the instruction at which you want the single-step to stop, because the stop depends on the address of the next step being exactly equal to the breakpoint. If the breakpoint points to the second byte of a two-or-three-byte instruction, you routine will never stop until you crash or hit BREAK.

W Window switch. Switches the optional full-screen display after each step. The first time you hit shift-W switches the display in, the second time switches it out, etc. Before you use this command, you must first have used the FUNCTION-9 command in write mode to set up an alternate display file.

Y Print screen. Copies current screen to printer.

ON NAMES AND NAMING

HOT Z labelling or NAMing system is intended to make the programs you are reading or writing more comprehensible when they are listed. The four-letter limit is imposed by the 32-column ZX display. A space is not a legal character in a HOT Z NAME, so use a dash or other punctuation if you want fewer than four letters.

The NAMEs themselves and the addresses they assigned to are contained in a special file, referred to as the NAME file. A NAME file is an ordered list beginning with the highest address to which a NAME is assigned (two bytes), then the four letters of that NAME, then the next highest address, etc. After the last NAME in a file, there must be two zero bytes. HOT Z takes care of ordering the NAMEs for you.

A small NAME file is loaded every time HOT Z is loaded, and that file contains four-letter abbreviations of the system variables as well as HOT Z's variables. You will find a few extras in the crowd from 4000 to 407D. LINK, TADD, and ASIM are used by the single stepper. TEM1 through TEM9 are slots for temporary 16-bit variables for various HOT Z routines. (You may use them for any of your own routines for values that are not required once the routine is over, provided your routine does not call the floating-point calculator.) HZET (407B-C) holds HOT Z's restart address for those cases when you (or HOT Z) are using ROM routines and stumble into one of the BASIC error traps.

The permanent NAME file that loads with HOT Z can be expanded to hold any NAMEs you add in a session of using HOT Z, or you have the option of starting a new file from scratch. In the standard 16 and 64K versions, the permanent NAME file is located just above a large work area, and as you add NAMEs the file expands *downwards* in memory (to lower addresses).

Add a NAME to the file with the shift-G command in WRITE mode with a disassembly (not data) on screen. The command will give you a cursor in the NAME column and allow you to enter or replace the NAME for that address. A legal NAME is made up of any four single non-inverse characters with the restriction that at least one character must be beyond F in the alphabet. If you forget that rule, HOT Z will refuse to accept your new NAME and will ask you for another. A space in a NAME will be accepted and the disassembler will list the NAME, but you will not be able to use such NAMEs when working with the assembler, which parses according to spaces and punctuation. Take care that your NAMEs are unique, or HOT Z will always find only the one at the higher address when you refer to it. (If you enter a NAME to the ADDR cursor before you assign it, then the NAME file will be searched and the display will move to that NAME if it is already there; otherwise the display stays put.)

The THEN key (WRITE) will delete a NAME at the cursor address from the screen and from the NAME file.

The shift-T command (READ) is there to let you find the start of your current NAME file. You may want to check up on it if your are working under crowded memory conditions to be sure the file doesn't overwrite some valuable code. This command switches the display to data and moves to the lowest address of the NAME file. Since the NAME column in the data display lists NAMEs assigned to addresses formed by pairs of bytes in the hex column, the NAME appears horizontally across from the first address byte and then vertically opposite the last four data bytes. (Be aware that chance occurrences of data can look like addresses and cause spurious listings in the NAME column of the data display.)

You should also use the shift-T command when it comes time to SAVE the NAMEs you have entered in a session. However, you will also need to know the end address of your file in order to SAVE it. You can call up that end address by entering NEND to the ADDR cursor; the end address of the NAME file is listed lo-hi there. You can either add 2 to that address to include the two zero bytes that act as a terminator, or you can remember to zero those two bytes after you reload the tape. If you choose the first option, hit shift-T, turn on the edit cursor, set END to NEND+2, and SAVE. Record the addresses for use when you reload.

When you reload a NAME file, you must install the start and end addresses so that HOT Z will know where to look for that file. This is done at the six-byte block labelled ALNA (alternate NAMEs) in the permanent NAME file. With the data display and the edit mode, write the start address twice (lo-hi) followed by the NEND address; don't forget to subtract 2 if you have included the terminating zeroes. (If you have not included them, make sure they are there *first*.) If you don't do these settings correctly, you will hang up the program when you try to switch the new file on.

The NAME-file switch command is shift-H in READ. It will switch from the permanent NAME file to the one you have loaded, after you have installed the file parameters at ALNA. If you use shift-H without installing the new parameters, the effect will be to switch off the NAMEs entirely and you will not be able to add new ones.

You can amalgamate NAME files only if they pertain to separate blocks of memory, with the addresses in one block all higher than those in the other. Then just load the two files end to end in the proper order and save them as a single file.

HOT Z NAMES IN PERMANENT FILE

AFEX	7FDØ	Store for AF' register pair in single-stepper
AFRG	7FDC	Store for AF register pair in single-stepper
ALNA	7FEØ	Alternate NAME file descriptors. Six bytes.
ASIM	4Ø76	Single-step simulation area. Five bytes.
BCEX	7FCE	Store for BC' register pair in single-stepper
BCRG	7FDA	Store for BC register pair in single-stepper
BPT2	7FBC	Breakpoint #1 address
BPT2	7FBE	Breakpoint #2 address
CADR	7FFE	Current address for disassembly
CBFL	7FF5	Flag for a bit-op prefix (CB)
CHOO	6A89	Selects and updates Read mode display
COUN	7FB6	Counter for printing register values
DEEX	7FCC	Store for DE' register pair in single-stepper
DERG	7FD8	Store for DE register pair in single-stepper
EDDO	7FF4	Flag for ED prefix
EOPA	7FEA	The END address
FCBO	7FF3	Flag for prefixed bit ops
FENS	7F9E	Single-step window switch; holds CRUN if off
FILC	7FB4	Fill character, normally zero for screen clear
HLEX	7FCA	Store for HL' register pair in single-stepper
HLRG	7FD6	Store for HL register pair in single-stepper
IXRG	7FD4	Store for IX register pair in single-stepper
IYRG	7FD2	Store for IY register pair in single-stepper
KADD	7FFE	Address pointed to by the cursor
KEYB	737E	Gets code of keystroke into A; preserves other regs
KLIN	7FF2	Line number with cursor
KPOS	7FFØ	Screen address of the cursor
KRED	7DE3	Puts cursor address into HL and KADD
LENI	7FE6	Length of current instruction in disassembly
LFPO	7FBØ	Stores address for floating-point interpreter
LOSI	7FC4	Last one-step instruction
NADD	7FFC	Next address for disassembly
NASW	7FF8	Switch for NAME lookup
NEND	7FFA	End of NAME list
NOSI	7FC6	Next one-step instruction
NTOP	7FF6	Most recent leading (low) address of NAME file
OSDF	7FC2	One-step display file for extra window
OSDP	7FCØ	One-step display point for window, as DFCP
OVER	7FF0	Overflow warning for User's stack
POIN	7FBA	Pointer used in building register-value display
PRIM	7FB8	Space or prime for register display
SPBI	7FDE	Stack-pointer storage bin for stack switches
UNDR	7F9C	Underflow warning for User's stack
USRS	7FC8	Single-step user's stack pointer. Sets with S.

NOTE: The high byte of variables for the 64K version is FE rather than 7F. Low byte is the same. All other addresses are identical.

THE BIG REM

There is a REM generating program that was published in a back issue of SYNTAX, and those of you who have it may want to install it and use that to create a BASIC line to hold your machine code routines. However, you may find the following approach more instructive on how to manipulate BASIC from the machine level. We have taped Big REM and included it after the 16K version of HOT Z on your master tape. Big REM fills all of the available workspace in a 16K memory.

Big REM can be used with either version of HOT Z-II, although it can only be joined together on a single tape with the 16K version. First LOAD HOT Z. You can LOAD Big REM without exiting HOT Z by setting END to 4DCØ, putting the cursor at 4ØØ9, and giving the LOAD command. You can also exit HOT Z with the Ø command, LOAD Big REM from BASIC, and return to HOT Z with the appropriate RAND USR command. One thing you cannot do (with 16K) after loading Big REM is to add BASIC lines in the conventional way, because your memory is essentially full and you will start overwriting parts of the HOT Z files.

With Big REM loaded, you can start writing your machine-code routines at 4Ø82, which contains the character zero (1C) as a marker, as does the last usable byte (4AA4). When you finish, then you will want to cut off the REM statement so that your code just fits. The necessary information to do that is contained in the chapter on BASIC line formats in your BASIC manual. If you look at 4Ø7D and following with Big REM loaded, you will see the line number in high-low order (ØØØ1H) and then the line length in low-high order in addresses 4Ø7F-8Ø. That length is ØA25H. If you add that value to the next address, 4Ø81 (the address of the token for REM (EA)) then the sum equals the location of the display file (ØA25 + 4Ø81 = 4AA6).

You should use this relationship to "clip off" the BASIC REM with your routine in it. If, for example, your last byte of code is at address 44ØØ, then you will need a line ending (76H) at 44Ø1, and a line number at 44Ø2 and 44Ø3. If you want that line number to be a 2, then put ØØ at 44Ø2 and Ø2 at 44Ø3. (For higher line numbers, remember that this is a hex value, not decimal.) Now you need a line length at 44Ø4-5 and a REM token (EA) at 44Ø6. The line length will be the difference between this address (44Ø6) and the display file address (4AA6 - 44Ø6 = Ø6AØ), so put the low byte (AØ) into 44Ø4 and the high byte (Ø6) into 44Ø5. That will create a second BASIC line; however, the first line is still specified as being the full length, so you must go back and change the length of the first line.

In this case, the line length plus the address of the first token (here REM) must sum to the address of the first byte of the next line number, which is 4402 in our example. Since 4402 - 4081 = 0381, put 81 in 407F and 03 in 4080. You can now switch into BASIC with the 0 command and delete line 2 in the normal way, then SAVE line 1 for later merging with your BASIC program.

Using HOT Z NAMEs with Big REM requires one of two approaches. You could start by shortening the REM statement before you write your code in order to leave room for the resident NAME list to expand. Just clip off a suitable portion as described above and come back to HOT Z with the USR call. A more convenient approach would probably be to locate the NAME file for your routine at the high end of the big REM statement. (See the notes on NAMEs and Naming.)

You can do that by just writing the address 4AA2 into the three address slots at ALNA, then using the H command (Read) to switch to the empty NAME file. Or you might want to transfer all or part of the permanent list into the REM before you do the switch. (Be careful not to transfer over the end of the REM statement, which would destroy the line end and the beginning of the display file.)

If you put the NAMEs for your routine in the top of the REM, then after you split the REM you will have your routine in line 1 and the NAMEs in line 2. You should then SAVE both lines as a working copy for future revisions, then delete the second line and SAVE again for merging with a BASIC program.

Combining Big REM and the 16K HOT Z

You can combine the 16K version with Big REM so that they LOAD as a single program. LOAD the two programs as described above. Write an 80H at 7F1F to indicate the end of a variables area, then go to the systems variables area and change ELINE, STKBOT, and STKEND so that each holds 7F20 (low-high order!). Then SAVE the whole thing from BASIC. When you reLOAD, you will have to start HOT Z with a direct RAND USR call. You cannot write any BASIC or declare any BASIC variables with this version, and you should decouple the two parts after starting HOT Z by restoring ELINE, STKBOT, and STKEND to hold 4DC0. What this linking does is to make HOT Z look like the variables area of a BASIC program.

If you own Z-TOOLS or a comparable utility program, you can merge the 1 REM's created in this way with BASIC programs that lack a line 1.

If you are not using Big REM, or if you have completed the line-chopping described above, and want to write a BASIC program of some size with HOT Z still resident, then you should move RAMTOP and the stack below HOT Z before you use shift-0 to go off and write BASIC. In 64K, put RAMTOP below 5800H to protect HOT Z; in 16K, put it below 4E00.

USING THE RELOCATE COMMANDS (F-8,F-9)

The Relocate command is rather complex in order to provide you a degree of flexibility in relocating your routines. A set of nine addresses must be entered before using the F-8 command, and a certain amount of planning and knowledge of the subject program is required to derive the correct addresses. Simple programs with one or two calls or absolute jumps are best labelled, moved with the Transfer-with-NAMEs (F-6) command, and then fixed up by hand.

A program of reasonable complexity will have a block of code, a block of data (which may include address lists or jump tables), and a block of variables. Good programming form would recommend that you keep these blocks separate and distinct rather than, say, mingle data and variable storage in the crannies between your subroutines. If you are programming with HOT Z, you can separate the blocks generously as you develop your program and then use the Relocate command to close the gaps when you finish. Separation of code and data also allows you to make efficient use of the ZX memory architecture, since there is generally some block of memory that can be used for data or variables but not to run code. (Above 8ØØØH in unmodified machines, above CØØØH with the Oliger modification and the standard screen driver.) So don't clutter up you active memory with data files if you have more than 16K of RAM.

HOT Z's Relocate command will work on program blocks where code, data and variables are separate and distinct. If you have embedded patches of data, the command may still work, but you should check the data after the relocation to make sure that it has not been changed under the guise of readdressing code. Programs such as the BK ROM, where jump tables lie around like empty beer cans, would have to be broken up into segments and relocated piecemeal.

The Relocate routine readdresses and moves Z8Ø code. However, the command does not take account of overlapping segments between source and destination blocks, so you cannot directly relocate a program to addresses already occupied by that program. (In such cases, you should use the transfer command first and then readdress in place with the relocate command.)

Jump tables have to be revised with the F-7 command, which first asks you for a displacement and then adds that displacement to each address in the file, starting at the cursor and ending at the END address. (If you moved your code from 41ØØH to 44ØØH then the displacement would be Ø3ØØH; from 44ØØH to 41ØØH would be a displacement of FDØØH.) Jump tables and data blocks should be moved with the Transfer command prior to using the relocate command.

The F-8 command (Relocate) allows you to move the code block by one displacement, the data block by another, and the variables block by a third displacement. (Any other three-way separation should also work.)

ADDRESS ENTRY FOR RELOCATING

The variables TEM1 through TEM9 are used to set the nine address parameters for relocation. The nine addresses are three sets of three addresses. Each set of three addresses indicates the start and end of an address range to be changed and the start address of the new address range. For example, suppose your program to be relocated fit the following memory map:

```
44D0-44E8  Variables
44F0-44FF  Data
4500-4680  Program
```

Suppose you have 32K and want to put the variables and data at 8100H and the program at 4C40. First, transfer the variables block to 8100H; it will run to 8118, so transfer the data block to 8119-8128. You want to move the program from 4500 up to 4C40, so any addresses of jumps or calls that lie between 4500 and 4680 should be changed to lie between 4C40 and 4DC0. (You don't need that last number.) So enter the original range in TEM1 and TEM2 and the first address of the new block in TEM3, thus:

```
TEM1  4500
TEM2  4680
TEM3  4C40
```

These first three TEM values always hold the parameters relating to the program (code) block. Variables and data parameters can go interchangeably into TEM4-TEM6 or TEM7-TEM9.

Addresses of variables, which were at 44D0-44E8, must be changed to start at 8100, and addresses of data, formerly at 44F0-44FF, must be changed to begin at 8119, so fill in the remaining TEM slots as follows:

Variables		Data	
TEM4	44D0	TEM7	44F0
TEM5	44E8	TEM8	44FF
TEM6	8100	TEM9	8119

TEM4-6 are one block, TEM7-9 the other. Now set the cursor at 4500 (start of the code segment) and set END to 4680, then give the FUNCTION-8 command. The code will be copied to the new location and readdressed to run with the new variables, new data block, and any relocated subroutines in the code block. The original code will remain unchanged at its original location.

You may also use the Relocate command to split a code block into two or more separate blocks, but you must apply it repeatedly, once for each of the end-product blocks, and readdress for the blocks that are not being moved as if those blocks were variables or data.

If you lack variables or data blocks, then use a single non-zero dummy value for all three of the second or third set of TEM values, i.e., make them all three the same.

The relocator leaves unchanged any ROM calls or any loads to or from the systems variables area (4000-407C).

RELOCATING HOT Z

In 16K

Relocating the program that does the relocating is a special case of using the Relocate command. Lack of space in 16K prevents any useful relocation of the entire program. You could, however, clear away some of high RAM by moving the parts of HOT Z that occupy those addresses into the work space below 4E00. This would allow you to write and debug a routine intended to run above RAMTOP with a BASIC program.

To do that, begin by moving the stack with the FUNCTION-2 command. Set the cursor to 4D80 and give the command. (There will be no visible on-screen effect unless you have set the SP display (shift-2 in READ)). Next move the HOT Z variables, which occupy 7F80-7FFF, by using the Transfer-with-NAMEs command (FUNCTION-6). Set the cursor to 7F80, set END to 7FFF and give the command, followed by 4D80 as DEST. This copies the variables to 4D80-4DFF, but it does not yet readdress the HOT Z code to use variables at the new location. To do that, set the following TEM values:

Code		Data		Variables	
TEM1	5800,	TEM4	4400,	TEM7	7F80
TEM2	7EFF,	TEM5	4400,	TEM8	7FFF
TEM3	5800,	TEM6	4400,	TEM9	4D80

The data entries are dummy values intended to have no effect, since the data tables stay put. Finally, set the cursor to 5800, set END to 7F20 and give the FUNCTION-8 command. After that, you may clear 7F20-7FFF with the FUNCTION-0 command and use it as workspace.

If you are more ambitious still and hungry for high memory, it is possible to move a part of HOT Z from the high addresses to your low workspace. (If not, skip the next few paragraphs.) You need to pick a point in the code across which there are no relative jumps: 7870 is one such. Since this is not a simple relocation but a splitting up of the

program, several extra steps are necessary. Assuming you have already moved stack and variables, as described above, first relocate the code from 7870-7F20 to 4670. Next, we will readdress code left behind (5800-786F) to send its calls and jumps to the transferred block; finally, a small fix to the jump tables is necessary.

For the initial relocation, set the following TEM values:

TEM1	7870,	TEM4	4400,	TEM7	4400
TEM2	7F20,	TEM5	4400,	TEM8	4400
TEM3	4670,	TEM6	4400,	TEM9	4400

Set the cursor to 7870, END to 7F20, and give the FUNCTION-8 command. The first column leaves the original code in place and produces a relocated and readdressed version at the new location (4670-4D20). The remaining columns hold dummy values and produce no effect. The original section of the code will still make its calls and jumps to 7870 and above, so it is necessary to readdress that block too.

Again, set the TEM values:

TEM1	5800,	TEM4	4400,	TEM7	7870
TEM2	786F,	TEM5	4400,	TEM8	7F20
TEM3	5800,	TEM6	4400,	TEM9	4670

Set the cursor to 5800, END to 786F and give the FUNCTION-8 command. The first column leaves the code in place and the third changes any references to the high addresses to the new code block. The jump tables still contain a pair of references to the moved code, however. Change the two 78's at 50EB and 50ED to 46's. (If you moved a bigger chunk, you would have to search through the jump tables and change each reference to the moved block.) Now you can clear memory from 7870 to 7FFF and use that as work space.

Since the above relocation hems in the NAME file, you must either forego using labels or relocate the NAME file into your new workspace, which is relatively simple.

Larger Memories

If you should expand your RAM or install one of the modifications that allow you to program parts of high RAM, then the following relocations may be useful.

From 16K to 32K (unmodified computer): This case allows you to move files and variables to high RAM, but the program must still be located below 8000H in order to run. The files of the 16K version are located at 5048-57FF; let's move them to B748-BEFF, leaving BF00-BFFF for variables, which are currently at 7F00-7FFF. Set the following TEM values:

Code		Data		Variables	
TEM1	5800,	TEM4	5048,	TEM7	7F00
TEM2	7EFF,	TEM5	57FF,	TEM8	7FFF
TEM3	5800,	TEM6	B748,	TEM9	BF00

It is important first to copy the files and variables up to their new locations, so first transfer the data and variables blocks to their respective new locations, leaving the old copies temporarily intact. Transfer the variables (7F00-7FFF) first, using the Transfer-with-NAMEs command (FUNCTION-6). This will change the NAME file for the new version. Then use the shift-T command to get to the start of the NAME file (4E0C). Turn on the cursor, set END to 57FF, and transfer to B50C. (That puts 5048 into B748, etc.)

Now set the cursor to 5800, set END to 7EFF, and give the FUNCTION-8 command. After the return from that command, you may erase the original data and variables areas for your own use.

This relocation requires no readdressing of jump tables because the code is left in place, but there is one small block of single-step code which is embedded in the data and copied out whenever the single-stepper is used. This block originates at 570F-572B and will have to be readdressed by hand if the code block had been moved. Details of this fix are in the next example.

There is just one change to be made in the data section to initialize to the new NAME file location on loading or restarting. The initial file location is set from the six bytes at BEF4 and following. Change BEF5 and BEF7 from 4E to B5 and BEF9 from 50 to B7.

Having done this readdressing, it is useful to make yourself a loader, so that you can load in the new version directly and don't have to relocate every time. The easiest way to make a loader is to modify the existing one by loading the entire HOT Z-II tape into memory and modifying it. For the example relocation, you can load the HOT Z-II tape as a data tape from 8009H to B4E5. The code that loads HOT Z to the proper addresses will be at 83A8 and will have to be modified.

First, however, the readdressed program segment from 5800 to 7EFF should be copied into the loader with the transfer command. Set the cursor and END to these two addresses and transfer to 8DC4. Next, set the cursor to B50C and END to BEFF and transfer to 83D0. This moves the files into place.

Now modify the code at 83A8 to read as follows:

```
LD HL,43D0
LD DE,B50C
LD BC,09F4
LDIR
LD HL,74E3
LD DE,7F1F
LD BC,2720
LDDR
CALL 0F23
JP 403C
```

If you use the insert command (EDIT) before each of the first four instructions, you can preserve and use what is already there, but change the LD BC to 2720.

Ready at last. SAVE from 8009 to B4E5 and the resulting tape should load normally and initialize the relocated version.

One of the hazards of loading a large program such as this is the possibility of writing over the machine stack when you copy up the program. In this case, the stack is in the eventual workspace (7F00-7FFF) and is safe. However, if you engage in non-standard addressing or have a revised ROM in your machine, then be sure the stack is in a safe place before loading HOT Z.

Moving HOT Z to High RAM

If you have a suitable memory for the project (Oliger or Memotech or possibly another: not a Byte-Back M-64 or a Super Z.) and make the Oliger modification to your computer (See SO v2.n2.), you can run machine code in the 32-48K block (8000H-BFFF), or if you have a separate display board, you may be able to use the entire 64K for programs. In that case, you should convert HOT Z to run entirely in another block of memory. Here's how to move the 64K version to 9800H, keeping the variables and files in the top 16K of a 64K memory.

(You ought to test your modification first by using HOT Z to write a simple little routine like CALL 0A2A, CALL 737E, RET somewhere in the newly opened-up memory area. This just clears the screen, waits for a keystroke, and comes back to HOT Z, but you can't normally run it at, say, 8100H. Set the cursor to the first instruction and give the shift-R command to Run it. If it doesn't work, then either your mod is incorrect or your memory has some prevent circuit in it.)

Load the 64K version. Set the following TEM variables:

Code		Data		Variables	
TEM1	5800,	TEM4	5000,	TEM7	5000
TEM2	7F1F,	TEM5	5000,	TEM8	5000
TEM3	9800,	TEM6	5000,	TEM9	5000

This will cause the program code to be rewritten at 98ØØ and following addresses with all calls and jumps readjusted but with the same variable and file addresses. (Values in TEM4 through TEM9 are dummy values that prevent anything from happening. Use any one non-zero value for these, but keep them all the same.)

Set the cursor to 58ØØ and END to 7F1F and give the FUNCTION-8 command. If you have done things correctly to here, you will find the readdressed program beginning at 98ØØ. Don't try to run it yet. Unlike the earlier example, the jump tables must be readdressed because the program itself has been moved.

The jump tables for the standard 64K version begin at F648 and end at F76D. Since both copies of the program are in memory, you can just readdress the tables in place. Use the FUNCTION-7 COMMAND to change the jump tables. (Cursor at F648, set END to F76D, hit FUNCTION, then 7, set DISP to 4ØØØ, because the move from 58ØØ to 98ØØ is a displacement by that amount, ENTER.) Now check the address at F754 and change it back to 4Ø76; since that address is in the systems variables area, it does not change.

At this point, you are running commands in one version and control in the other. Now switch to the new version by setting the cursor to 98ØØ and giving the shift-R (Run) command. That should bring up the ØØØØ address as the program restarts in the new version.

The single-stepper requires one more set of changes. There is a small patch of code embedded in the data section that is copied out for single stepping. You will find it at FDØE to FD2B (FD2C isn't!) There are seven JP's and one CALL in that area. It is generally quicker to revise those eight addresses than to use the FUNCTION-8 command, though you could use it by setting TEM1 = FDØE, 2 = FD2B, 3 = FDØE, 4 = 58ØØ, 5 = 7F1F, 6 = 98ØØ, and the other three with a dummy, say 5ØØØ. If you revise the addresses by hand, just add 4ØØØ to each. *Don't* change the JR. (The new addresses will all begin with either A9 or AA.) You should now have a fully converted version that runs in the 32-48K block of your modified computer's memory.

To make a loader for this new version, load in the original tape from 44Ø9 to 794F. (You may first want to erase the old version at 58ØØ-7F2Ø with the FUNCTION-Ø command.) Now all you have to do is to copy the various blocks into the appropriate spots in the loader, change a few loading addresses, and resave the same block to make a loadable tape. (Addresses 44Ø9-447C will contain the system variables that normally load to 4ØØ9-407C.)

at 47B6, change the LD DE,7F1F to LD DE,BF1F. That will load the program to its new memory residence. At 443F, change the CALL 737E to CALL B37E. That calls the relocated keyboard scan while the cover is on screen. At 4442, change the LD BC,1468 to LD BC,3B68. That clears away the loader after it has done its job. Change the JP at 444F to JP 98ØØ. That starts the program.

Now set the cursor at 98ØØ, END to BF1F, and Transfer (shift-T) to 47DØ. Next, cursor at F3AØ, END set to FDFE, and Transfer to 6EFØ. If you want to change the version number and memory-occupation listing on the cover, look at 466F and following with the data display and make the changes in the Edit mode. Finally, record over the initial address space (44Ø9-794F). The resulting tape should load from BASIC, install HOT Z, and jump to the cover, just as your original version does.

THE ONE-STEP WINDOW

The Single-Step display window requires a second full display file for the cumulative screen print of the routine you are stepping through. Since such a display file takes up 768 bytes of memory that you might otherwise use for programming, the program requires you to specify where you want to put the second display file. Such a file can be anywhere in memory since it is moved into the proper location at each step. Just assure that the following 768 bytes contain nothing you want to keep. Then set a cursor to the start of this area and give the FUNCTION-9 command to initialize the file and hook the window into the single-step routine.

After you have initialized the second display file, you can switch the single-step display window in or out with the shift W command (Single-Step). If the window is "on", the screen will come up with a pause for a keystroke at every step. Since only a few steps will actully print to the screen, you may want to keep the window off and refer to it only occasionally. Restart HOT Z (shift R in READ) to get rid of the window entirely and reclaim the memory space.

The window will normally flash on screen for each step, but there will be no pause unless you first give the W command, then hit ENTER to run a step. Any key will take you back to the register display, but note that the V key is also a CLS command for your window display. A CLS puts the print position back to the top left screen corner.

If you use RST 10 to print to the display window, you can run the whole RST 10 routine in the same way you would a CALL to a subroutine, by hitting shift-R in single-step mode.

NOTES ON MAKING EPROMS

At the moment, the only possibility of putting HOT Z-II on EPROM is to use two 2764's (or a 27128) or the equivalent with some kind of modified memory system. This means you will have some extra space for your own routines as well, and you may want to hook up some of them to HOT Z.

The command lists have two kinds of user-slots for extra commands, marked as "Dead keys" and "User hookups". If you work entirely in RAM, then treat both categories as equal. Just replace the current address in that jump-table slot with the address of the routine you want to run as a command for the corresponding key.

If you make your own EPROMs of HOT Z, then you have to treat Dead keys and User Hookups as quite separate opportunities. Dead keys will be truly dead in EPROM unless you enter an address before you burn an EPROM. If you have space for your favorite routines on the same EPROM with part of HOT Z, then you should hook up those addresses *before* you burn the EPROM. User hookups are still available after you burn the EPROM because they allow you to hook in routines you have just written into address slots in the variables area. Addresses for those slots are listed on the command sheets. It is often handy to hook new routines of any sort into HOT Z and to run them as commands.

Most available slots have been left among the Write commands because those commands allow the greatest flexibility. If you want to add to that flexibility, write your own command processor and make the entry into that a HOT Z command. That is roughly how HOT Z ties together the Read command mode with the Write modes and the single-step. I use a jump table for all command-processing loops and advise anyone using HOT Z to take the same approach because there is a lot there that you can borrow. (For example, a CALL to this version's KEYBoard routine will preserve all register values except for the accumulator, which comes back with the code of the first key pressed. It does use the EXX registers.)

With a Write command, you should have the cursor address available to you as well as the END address. The END address is always available by loading from the HOT Z variable EOPA, which is included in the permanent NAME list. The cursor address should be read at the start of a routine with a CALL KRED (cursor-address read), which brings back the cursor address in HL and updates it in the HOT Z variable KADD (cursor address). KRED is the address in the first CALL for the H key routine, for example, which is listed on your command sheet. KRED puts the cursor address in HL and into the HOT Z variable KADD.

If you have a routine that you want to make into a Write command, then you should decide what mode of HOT Z you want to return to, even if only eventually. A routine that ends in a RET must not destroy the existing screen, or it will have no context to return to. (It will come back, though, to an anonymous address and in Write mode but with no cursor, at which point you should press ENTER.) If you want to use the screen then you should choose to return to Read mode, which is the "home base" of HOT Z. To do that, you should POP the first RETurn address and dispose of it, then load HL with the address CH00 and do an EX (SP),HL. If you do that, you can even control the address to which the HOT Z display returns by loading CADR before you RETurn.

In other words, if you want to use the screen, and to know the address at which the command was issued, prefix your routines with:

```
POP HL
LD HL, CH00
EX (SP),HL
```

and end them with a RET.

Commands that do not use the screen can restore the cursor position with a CALL KRES. You can move the cursor one line down with CALL KDWN or move it up with CALL K-UP, either just before the RET.

Commands appended to the single step may need to use the address in the NEXT slot, which is stored in the variable NOSI (next one-step instruction).

THE FLOATING-POINT INTERPRETER

RST 28H is the entry into the ROM's floating-point operations, which are coded in the bytes between an RST 28 and the following 34H. There is a good explanation of this second language (Or is it third?) of the ZX in Dr Logan's article in SYNC 2.2. (But beware of the two sign tests, which aren't jumps, as labelled in SYNC.)

HOT Z will read this floating-point language, but only after you turn on the floating-point interpreter (shift-W in READ). If you leave the floating-point interpreter turned on, you will get a true reading of the ROM, but problems can arise elsewhere in memory when you encounter an EF that functions as data rather than an RST 28. You may get locked into the floating-point interpreter mode, without a 34H, the END character, in sight. The way out from this barrage of gibberish is the shift-W command again, which switches out the floating-point interpreter entirely. Other times you may want to read it, because this extra language is really one of the treats of the Sinclair-calculator heritage.

The f-p interpreter is also turned off by entry of a numerical address, but not by a page flip or a NAME, so use the last two when you're working with f-p. In addition, there is a special key command, TO in READ mode, which switches the flag that tells the disassembler which language it's in.

The TO command (READ) has a dual purpose. It will get you out of floating-point mode (without turning off the interpreter) if you need to and can't, or it will get you in when you want to be but aren't. You may get stuck in that mode through addressing yourself into the middle of a Z80 instruction, for example. Since floating-point operations include jumps and loops, there are also inclusions of f-p code that do not begin with an RST 28, branches of jumps. The TO command will get you into those branches. However, the command is just a bit switch and it doesn't function when the screen page itself switches from one language at the top to the other at the bottom. The cure, when the TO command doesn't function is the cute trick of hitting the shift-D key twice. This picks up the language mode from the bottom of the page to the top and reverses the reading of any bytes from one language to the other.

You will also encounter some queer behavior if there is f-p code at the bottom of the screen and you try to write or go to the One-Step. This is not generally fatal and can be cured by going back to disassembly and setting the screen so that it ends in Z80 disassembly. If you want to write f-p code, the only manageable way is to go into EDIT mode (shift-E).

Another consequence of jumps in the f-p language is that an RST 28 may be embedded in a run of f-p language as a second entry point. In these cases, EF gets misread as GET F, which is a particle of nonsense, but it really is an RST 28, and would read as such if you called it by address to the top of the screen.

Floating-point operations are FORTH-like stack manipulations and easy to follow if you know something about that language. They use the MEM area of the systems variables as storage slots for six floating-point numbers. (Each is five bytes.) The f-p operations that transfer between the calculator stack and MEM are called GET and STOR and are followed by a single digit from Ø to 5 to indicate the slot used. Numbers or letters higher than 5 generally indicate a patch of nonsense with GET, STOR and STAK as well.

Many of the possible f-p operators do not occur in the coding of the ROM, where you are likely to encounter them with HOT Z. They occur instead during the ROM's reading of BASIC programs, and they are generally identical with a BASIC instruction. You could learn to write floating-point code with these and the purely machine-code f-p operators if you wanted to; it would be similar to BASIC and a little faster. The 'entry point' of these BASIC f-p operators into the real machine world is through the operation labelled RAFP (Run A as Floating-Point). However, you need only use the command numbers listed as the first column of the instruction list to perform those BASIC functions on whatever floating-point numbers are on the calculator stack. From the perspective of a HOT Z user, RAFP would be used only to run an operation that resulted from some calculation, whose result was a code in A.

Two of the f-p operations deliver data directly from the code listing to the calculator stack. They generally do this in an efficient way, using fewer than five bytes, if possible, to encode the five-byte floating-point number. HOT Z prints the encoded floating-point number in the NAME and mnemonics columns of the disassembly listing. Since the interpreter doesn't know where any number will end, it is necessary to begin all of them slightly out of column, or the longest would poke out the line-ends in the display file. The f-p interpreter also reads the full five hex bytes that go onto the f-p stack, rather than the condensed version that actually occurs in the ROM. The ADDR column keeps accurate track, and you can work out the extra bytes, which are generally trailing zeroes, from that column.

HOT Z prints floating-point data by using the same ROM routines that handle that data, so the disassembly slows down and becomes jerky when it has to print those huge numbers, or their single-digit versions.

The two data-stacking operations are labelled STFP (stack floating point) and SAPP (successive approximator; we've all met one). The first of these puts one five-byte number on the calculator stack, the second a series of one to 31 (whatever is left when you AND the low nibble of the instruction byte with ØF) five-byte f-p constants. (That's 5 to 155 bytes.)

When either of these operations gets stuck near the bottom of the screen without enough space to display all its floating points, then that same operation will begin again after the next page flip (P command) and boringly redisplay its whole repertory of numbers. The successive approximator in the ROM uses anything from six to a dozen floating point constants to get to a value for Chebyshev polynomials to approximate the transcendental BASIC functions.

FLOATING POINT OPERATIONS

Code	Op	Addr	Description
ØØ	JRT	1C2F	Jumps if stack top holds a true
Ø1	SWOP	1A72	Exchanges the top and second 5-byte stack entry
Ø2	DROP	17E3	Throws away top stack entry
Ø3	SUB	174C	Subtracts top stack from second stack entry
Ø4	MULT	17C6	Multiplies top two stack entries and leaves product on stack
Ø5	DIV	1882	Divides second entry by top stack and leaves quotient on stack
Ø6	PWR	1DE2	Raises 2nd on stack to power of stack top
Ø7	OR	1AED	Performs BASIC OR on two top stack entries and leaves result
Ø8	AND	1AF3	Performs BASIC AND on two top stack entries, leaves result
Ø9	N<=M	1B03	Numeric inequality test
ØA	N>=M	1B03	Numeric inequality test
ØB	N<>M	1B03	Numeric inequality test
ØC	N>M	1B03	Numeric inequality test
ØD	N<M	1B03	Numeric inequality test
ØE	N=M	1B03	Numeric equality test
ØF	ADD	1755	Adds two top stack entries and leaves sum on stack
1Ø	$AND	1AF8	ANDs a string with a number
11	$<=	1B03	String inequality test
12	$>=	1B03	String inequality test
13	$<>	1B03	String inequality test
14	$>	1B03	String inequality test
15	$<	1B03	String inequality test
16	$=	1B0F	String equality test
17	$TR+	1B62	Concatenates the strings addressed by the two top stack entries
18	NEG	1AA0	Changes the sign of top stack entry
19	CODE	1C06	Replaces top stack entry with its Sinclair CODE
1A	VAL	1BA4	BASIC function
1B	LEN	1C11	BASIC function
1C	SIN	1D49	BASIC function
1D	COS	1D3B	BASIC function
1E	TAN	1D6B	BASIC function
1F	ASN	1DC4	BASIC function
2Ø	ACS	1DD4	BASIC function
21	ATN	1D76	BASIC function
22	LN	1CA9	BASIC function
23	EXP	1C5B	BASIC function
24	INT	1C46	BASIC function
25	SQR	1DDB	BASIC function
26	SGN	1AAF	BASIC function
27	ABS	1AAA	BASIC function
28	PEEK	1ABE	BASIC function
29	USR	1AC5	BASIC function
2A	STR$	1BD5	BASIC function
2B	CHR$	1B8F	BASIC function
2C	NOT	1AD5	BASIC function
2D	DUP	19F6	Duplicates top of stack (5 bytes)
2E	@REM	1C37	Replaces number pair with quotient on stack top, remainder below

2F	JRU	1C23	Unconditional relative jump
30	STFP	19FC	Composes and stacks number from following data bytes
31	LONZ	1C17	Loop jump as DJNZ with BERG as counter
32	N<ØØ	1ADB	Tests sign of stack top and replaces with true if negative
33	N>ØØ	1ACE	Tests sign of stack top and replaces with true if positive
34	END	ØØ2B	Ends an RST 28 routine
35	AADJ	1D18	Adjusts angle values modulo 2 pi for trig functions
36	ROUN	1BE4	Rounds down to integer
37	RAFP	19E4	Uses byte in A as f-p op code and runs it; for BASIC functions
38	DEXP	155A	Decimal exponent processor
80	SAPP	1A7F	Successive approximator; stacks and processes constants
A0	STAK	1A51	Stacks Ø.1,Ø.5,PI/2,or 1Ø, depending on second nibble
C0	STOR	1A63	Recalls stored entry from calculator MEM slot in 2nd nibble
E0	GET	1A45	Stores entry in calculator MEM slot given by 2nd nibble

READ Mode Command File

File (64K)	File (16K)	Key (Shift)	Routine	Function
F65E	505E	A	7E30	Turn on assembly editor
F64C	504C	AND	63DE	Stack pointer display switch
F660	5060	D	6A74	Switch to data display
F658	5058	E	60C5	Switch to edit
F662	5062	F	63C4	Fix display file
F65C	505C	G		Dead key
F648	5048	H	5D53	Switch NAME file
F664	5064	Q	5D68	Quit to BASIC
F64E	504E	R	5800	Restart HOT Z (also RAND USR 22528)
F65A	505A	S	65E4	Switch to Single-Stepper
F652	5052	T	5CF5	Display top of NAME list
F654	5054	THEN	5BC1	Decimal address to follow
F656	5056	TO	63E7	Switch floating-point display
F64A	504A	W	5CEC	Switch off floating-point interpreter
F650	5050	Y	63F0	Print screen
F666	5066	F-1		Dead key
F668	5068	F-2		"
F66A	506A	F-3	5D71	User hookup (Routine addr at 7FA0/FEA0)
F66C	506C	F-4	6088	User hookup (Routine addr at 7FA2/FEA2)

Single-Step Command File

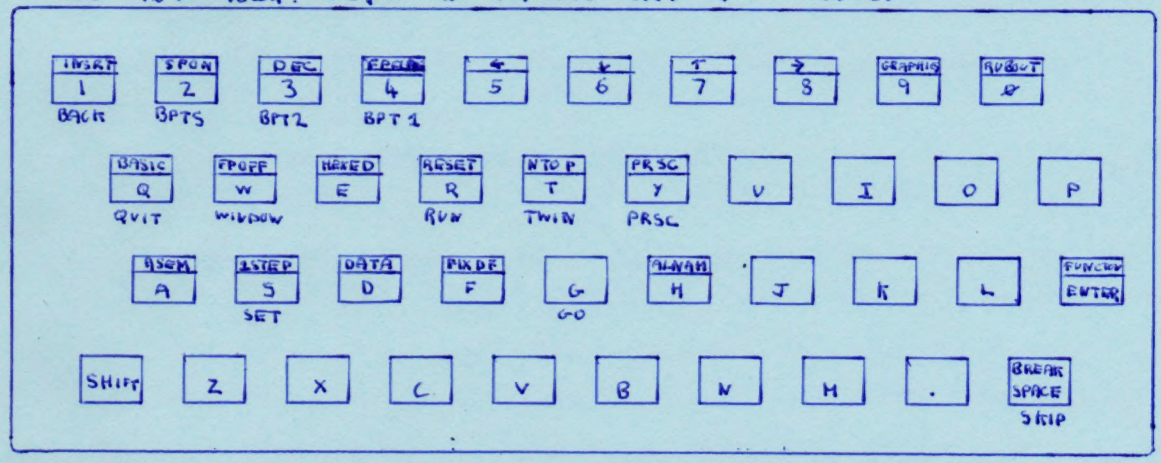
File (64K)	File (16K)	Key (Shift)	Routine	Function
F6DA	50DA	A		Dead key
F6C8	50C8	AND	6435	Display breakpoints
F6DC	50DC	D	A7D0	User hookup (Routine addr at 7FAA/FEAA)
F6D4	50D4	E		Dead key
		EDIT	----	Back up one byte
		ENTER	----	Run one step
F6DE	50DE	F	A946	User hookup (Routine addr at 7FAC/FEAC)
F6D8	50D8	G	63FD	Go to breakpoint
F6C4	50C4	H		Dead key
		Q	----	Quit single-step for disassembly
F6CA	50CA	R	6581	Run CALL or RST
F6D6	50D6	S	64A3	Set register value
		SPACE	----	Skip step
F6CE	50CE	T	6423	Twin breakpoints
F6D0	50D0	THEN	6469	Set breakpoint 2
F6D2	50D2	TO	645D	Set breakpoint 1
F6C6	50C6	W	65C0	Window switch
F6CC	50CC	Y	63F0	Print screen

WRITE Command File

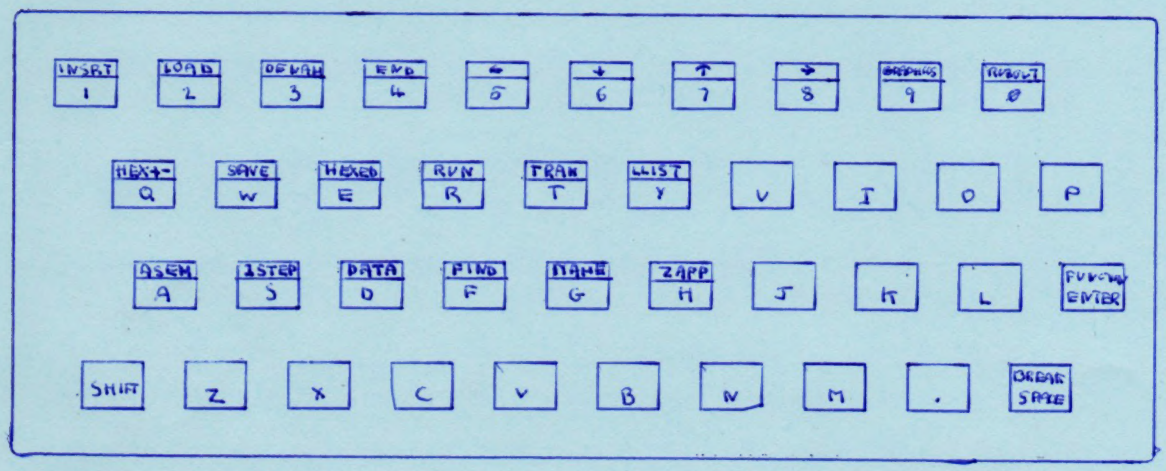
File (64K)	File (16K)	Key (Shift)	Routine Addr	Function
F684	5084	A	5F5A	Assembly mode
F672	5072	AND	5A61	LOAD from cursor to END
F686	5086	D	5E27	Display switch to DATA
F67E	507E	E	5F63	Edit mode
F688	5088	F	5C64	FIND string marked by cursor and END
F682	5082	G	5B4B	Christen with NAME
F66E	506E	H	5F7D	Delete instruction at cursor
F68A	508A	Q	5B1E	Hex sum and difference of cursor and END
F674	5074	R	5D47	RUN code at cursor (RET to READ)
F680	5080	S	65E0	Single step instruction at cursor
F678	5078	T	5847	Transfer
F67A	507A	THEN	5DD6	Delete NAME
F67C	507C	TO	6076	Set END variable
F670	5070	W	5A62	SAVE from cursor to END
F676	5076	Y	5D04	Print from cursor to END+
		EDIT		Set INSERT cursor
		ENTER		Quit to READ mode
F68C	508C	F-0	5EC4	Clear memory from cursor to END
F68E	508E	F-1	5EB1	Fill memory with specified character
F690	5090	F-2	5CCA	Move RAMTOP to cursor, stack just below
F692	5092	F-3		Dead key
F694	5094	F-4		"
F696	5096	F-5		"
F698	5098	F-6	584D	Transfer code and NAMEs to DEST
F69A	509A	F-7	5937	Readdress a jump table by displacement
F69C	509C	F-8	5980	Relocate code from cursor to END
F69E	509E	F-9	63AF	Initialize window for single-stepper
F6A0	50A0	F-A		Dead key
F6A2	50A2	F-B		"
F6A4	50A4	F-C		"
F6A6	50A6	F-D		"
F6A8	50A8	F-E		"
F668	5068	F-F	5C56	Find next occurrence of string
F6AC	50AC	F-G		Dead key
FCAE	50AE	F-H		"
F6B0	50B0	F-I		"
F6B2	50B2	F-J		"
F6B4	50B4	F-K		"
F6B6	50B6	F-L		"
F6B8	50B8	F-M		"
F6BA	50BA	F-N		"
F6BC	50BC	F-O		"
F6BE	50BE	F-P	61A3	User hookup (Routine addr at 7FA4/FEA4)
F6C0	50C0	F-Q	A3F5	" 7FA6/FEA6)
F6C2	50C2	F-R	A66D	" 7FA8/FEA8)

Hot Z-II Commands:

Read mode commands are listed at the top of the keys in the top of the two layouts below, single-step commands are listed on the same layout below the corresponding keys.
Write mode commands are listed on the lower layout. Function key commands are not listed. Refer to seperate list for those.



Read and single-step mode commands -



Write mode commands -

FUNCTION KEY COMMANDS:

Read mode -

F-3	2x-File interrupt driver routine
F-4	2x-FILE entry

Write mode -

F-0	Clear
F-1	Fill
F-2	Set ramtop
F-6	Transfer with names
F-7	Re-address
F-8	Relocate
F-9	Initialise window
F-F	Next find
F-P	User hook RVP (7FA4)
F-Q	User hook RVP (7FAC)
F-R	User hookup (7FA8)

ADDITIONAL INFORMATION:

Version 2.21-1
memory use $4E00 - $7FFFH (19968 - 32767)
Rand USR 22528 (5800H) restarts HOT Z (also SHIFT+R in READ mode)
Ramtop = 32640 ($7F80)
2X-FILE dependent version
Set Ramtop to 19968 + load as data
HOT Z-II is 12800 bytes long (12.5 K) ($3200)
2X-FILE - free from 13690 - 16383 (357AH - 3FFF H)
= 2694 (0A86 H) bytes free
REM - 4082 - 4AA4 (Useable)
Name file (start) = SHIFT+T (read) END = NEND(lo,hi) + 2
ALNA = start (lo,hi) * 2 and NEND address, then SHIFT+H (read)
VOL. FOR 2X-FILE = 100% (FULL)